

What is Claimed is:

1 1. A method of treating a substrate surface comprising copper or a copper alloy, the
2 method comprising:

3 applying to the substrate surface a composition comprising:

4 one or more chelating agents;

5 one or more pH adjusting agents to produce a pH between about 3 and
6 about 11; and

7 deionized water; and then

8 applying a corrosion inhibitor solution.

1 2. The method according to claim 1, further comprising treating the substrate surface
2 with a corrosion inhibitor solution prior to treating the substrate surface with the
3 composition.

1 3. The method according to claim 2, wherein the corrosion inhibitor solution
2 comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and
3 deionized water.

1 4. The method according to claim 3, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 5. The method according to claim 5, wherein the one or more chelating agents
2 comprise an acid, a base, or a combination thereof.

1 6. The method according to claim 5, wherein the one or more chelating agents
2 comprise an acid having a concentration of up to about 40 wt.% of the composition.

1 7. The method according to claim 6, wherein the acid is a carboxylic acid having one
2 or more acid groups.

1 8. The method according to claim 7, wherein the acid is selected from the group of
2 acetic acid, citric acid, maleic acid, and combinations thereof.

1 9. The method according to claim 1, wherein the one or more chelating agents
2 comprise a base having a concentration up to about 5 wt.% of the composition.

1 10. The method according to claim 1, wherein the base comprises between about 0.5
2 wt.% and about 3 wt.% of the composition.

1 11. The method according to claim 9, wherein the base is selected from the group of
2 ammonium hydroxide, ammonium hydroxide derivatives, amines, and combinations
3 thereof.

1 12. The method according to claim 1, wherein the composition further comprises a
2 corrosion inhibitor.

1 13. The method according to claim 12, wherein the corrosion inhibitor comprises
2 between about 0.01 wt.% and about 0.50 wt.% of the composition.

1 14. The method according to claim 12, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 15. The method according to claim 1, wherein the composition comprises up to about
2 40 wt.% citric acid, up to about 5 wt.% ammonium hydroxide, the remainder deionized
3 water.

1 16. The method according to claim 1, wherein the composition has a pH between about
2 4 and about 5 and comprises between about 5 wt.% and about 30 wt.% citric acid, between
3 about 0.5 wt.% and about 3.0 wt.% ammonium hydroxide.

1 17. The method according to claim 2, wherein the corrosion inhibitor solution is
2 applied prior to treating the substrate surface with the composition for between about 3
3 and about 10 seconds.

1 18. The method according to claim 1, wherein the composition is applied between
2 about 10 and about 20 seconds.

1 19. The method according to claim 1, wherein the composition further comprises a
2 reducing agent.

1 20. The method according to claim 19, wherein the reducing agent comprises between
2 about 0.01 wt.% and about 20 wt.% of the composition.

1 21. The method according to claim 19, wherein the reducing agent is selected from the
2 group of hydroxylamine, glucose, sulfothionate, potassium iodide, and combinations
3 thereof.

1 22. The method according to claim 1, wherein the corrosion inhibitor solution
2 comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and
3 deionized water .

1 23. The method according to claim 22, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 24. The method according to claim 22, wherein the corrosion inhibitor solution is
2 applied between about 3 and about 10 seconds.

1 25. The method according to claim 1, wherein the one or more pH adjusting agents are
2 selected from the group of a non-oxidating inorganic acid, a non-oxidating organic acid, a
3 non-oxidating inorganic base, a non-oxidating organic base, and combinations thereof.

1 26. The method according to claim 1, wherein the one or more pH adjusting agents
2 comprise an acidic chelating agent, a basic chelating agent or a combination thereof.

1 27. A method of planarizing a substrate surface containing:

2 an dielectric layer having an upper surface and at least one opening;
3 a barrier layer lining the opening and the upper surface of the dielectric layer; and
4 copper or a copper alloy filling the opening and on the dielectric layer;
5 the method comprising:
6 removing the copper or copper alloy layer and the barrier leaving an exposed
7 substrate surface comprising copper or copper alloy in the opening; and
8 treating the exposed substrate surface comprising copper or the copper alloy by
9 applying thereto a composition comprising one or more chelating agents, one or more pH
10 adjusting agents to produce a pH between about 3 and about 11, and deionized water;
11 and then applying a corrosion inhibitor solution..

1 28. The method according to claim 27, further comprising removing the barrier layer
2 after removing the copper or copper alloy layer and prior to chemically treating the
3 exposed substrate surface.

1 29. The method according to claim 27, wherein removing the copper or the copper
2 alloy layer comprises chemical-mechanical polishing (CMP) the copper or the copper
3 alloy layer.

1 30. The method according to claim 29, wherein the method comprises:
2 removing the copper or copper alloy layer and stopping on the barrier layer;
3 removing the barrier layer and leaving the exposed substrate surface comprising
4 copper or copper alloy features.

- 1 31. The method according to claim 27, wherein:
 - 2 the dielectric layer comprises a silicon oxide; and
 - 3 the barrier layer comprises tantalum (Ta) or tantalum nitride (TaN).

1 32. The method according to claim 27, wherein the method comprises chemically
2 treating the exposed substrate surface comprising copper or the copper alloy layer to

3 remove a portion of the substrate surface of the copper or copper alloy or to remove
4 corrosion stains from the copper or copper alloy substrate surface.

1 33. The method according to claim 32, wherein the method comprises chemically
2 removing up to about 50Å from the exposed substrate surface comprising copper or the
3 copper alloy.

1 34. The method according to claim 27, further comprising treating the substrate surface
2 with a corrosion inhibitor solution prior to applying the composition .

1 35. The method according to claim 27, wherein the composition comprises deionized
2 water, citric acid and ammonium hydroxide.

1 36. The method according to claim 27, wherein the method comprises:
2 mounting the substrate on a carrier in a CMP apparatus;
3 CMP the substrate using a polishing pad;
4 performing the initial treating step;
5 applying the composition; and
6 applying the corrosion inhibitor solution while separating the substrate from the
7 polishing pad.

1 37. The method according to claim 34, wherein the corrosion inhibitor solution
2 comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and
3 deionized water.

1 38. The method according to claim 37, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 39. The method according to claim 27, wherein the one or more chelating agents
2 comprise an acid, a base, or a combination thereof.

1 40. The method according to claim 39, wherein the one or more chelating agents
2 comprise an acid having a concentration of up to about 40 wt.% of the composition.

1 41. The method according to claim 40, wherein the acid is a carboxylic acid having
2 one or more acid groups.

1 42. The method according to claim 41, wherein the acid is selected from the group of
2 acetic acid, citric acid, maleic acid, and combinations thereof.

1 43. The method according to claim 27, wherein the base comprises up to about 5 wt.%
2 of the composition.

1 44. The method according to claim 43, wherein the base comprises between about 0.5
2 wt.% and about 3 wt.% of the composition.

1 45. The method according to claim 43, wherein the base is selected from the group of
2 ammonium hydroxide, ammonium hydroxide derivatives, amines, and combinations
3 thereof.

1 46. The method according to claim 27, wherein the composition further comprises a
2 corrosion inhibitor.

1 47. The method according to claim 46, wherein the corrosion inhibitor comprises
2 between about 0.01 wt.% and about 0.50 wt.% of the composition.

1 48. The method according to claim 46, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 49. The method according to claim 27, wherein the composition comprises up to about
2 40 wt.% citric acid, up to about 5 wt.% ammonium hydroxide, and the remainder of the
3 composition comprises deionized water.

1 50. The method according to claim 49, wherein the composition has a pH between
2 about 4 and about 5 and comprises between about 5 wt.% and about 30 wt.% citric acid,
3 between about 0.5 and about 3.0 wt.% ammonium hydroxide.

1 51. The method according to claim 34, wherein the corrosion inhibitor solution is
2 applied between about 3 and about 10 seconds prior to treating the substrate surface with
3 the composition.

1 52. The method according to claim 27, wherein the composition is applied between
2 about 10 and about 20 seconds.

1 53. The method according to claim 34, wherein the corrosion inhibitor solution
2 comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and
3 deionized water.

1 54. The method according to claim 34, wherein the corrosion inhibitor is selected from
2 the group of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

1 55. The method according to claim 27, wherein the corrosion inhibitor solution is
2 applied between about 3 and about 10 seconds.

1 56. The method according to claim 27, wherein the pH adjusting agent is selected from
2 the group of a non-oxidating inorganic acid, a non-oxidating organic acid, a non-oxidating
3 inorganic base, a non-oxidating organic base, and combinations thereof.

1 57. The method according to claim 27, wherein the one or more pH adjusting agents
2 comprise an acidic chelating agent, a basic chelating agent or a combination thereof.

1 58. The method according to claim 27, wherein the composition further comprises a
2 reducing agent.

1 59. The method according to claim 58, wherein the reducing agent comprises between
2 about 0.01 wt.% and about 20 wt.% of the composition.

1 60. The method according to claim 58, wherein the reducing agent is selected from the
2 group of hydroxylamine, glucose, sulfothionate, potassium iodide, and combinations
3 thereof.